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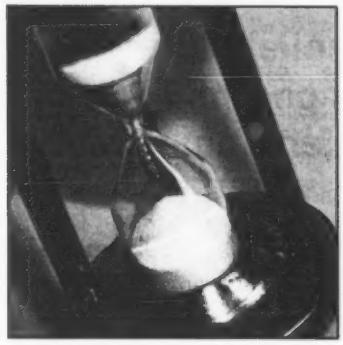

by Michael Tjepkema, Russell Wilkins, Sacha Senécal, Éric Guimond and Christopher Penney

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Abstract

Background
Aboriginal peoples experience a disproportionate burden of disease, compared with other Canadians. However, relatively little information is available about mortality among Métis and non-Status Indians.

Methods
This study calculates potential years of life lost before age 75 (PYLL) for people aged 25 to 74 by all-cause and cause-specific mortality, and examines the effect of socio-economic factors on premature mortality. Age-specific and age-standardized PYLL rates were calculated for 11,600 Métis, 5,400 non-Status Indians, and 2,475,700 non-Aboriginal adults based on the number of person-years at risk up to age 75.

Results
Métis and non-Status Indian adults had about twice the risk of dying before age 75, compared with non-Aboriginal adults. While the largest percentage of PYLL was due to non-communicable diseases such as cardiovascular disease and cancer, relative and absolute inequalities were greatest for injuries. Socio-economic indicators such as income, education and employment explained a large share of the disparities in premature mortality.

Interpretation
The results highlight the losses of potential years of life due to chronic diseases, as well as the possible importance of injury prevention programs for Métis and non-Status Indians.

Keywords
Aboriginal, cause of death, death rate, First Nations, indigenous, life expectancy, longevity, mortality

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As a result of a complex set of social, economic and environmental circumstances,[1] Aboriginal peoples experience a disproportionate burden of disease, compared with other Canadians.[2,3] Life expectancy, the most basic of health indicators, is considerably shorter for Status Indians (First Nations registered under the Indian Act of Canada)[4,5] and for people living in the Inuit-inhabited areas of Canada (80% of whom are Inuit).[6] But methodological challenges limit the amount of mortality information available about Métis and non-Status Indians.[1] In fact, relative to their population size, these two Aboriginal groups have been under-represented in health research in general.[7,8]

Mortality data for Métis and non-Status Indians are difficult to generate. Aboriginal ancestry, identity or status is not routinely recorded on death registrations. And because most Métis and non-Status Indians do not live in areas where they constitute a high percentage of the total population, their mortality patterns cannot be studied indirectly with an area-based approach.[6,9] However, the 1991 to 2001 Canadian census mortality follow-up study has made it possible to examine a wide range of mortality indicators for Métis[10] and non-Status Indians.

Mortality studies typically include all ages, and are, therefore, dominated by deaths at older ages. Results of such studies may reveal only part of the picture, especially for Aboriginal groups, who tend to have a high proportion of younger people. Premature mortality (defined here as deaths before age 75) and potential years of life lost (PYLL) before age 75 highlight the loss to society as a result of early deaths.[11] Premature mortality and PYLL rates are elevated among Status Indians,[12-14] and injuries are an important contributor to these high levels,[13,14] but PYLL has not been

calculated for Métis and non-Status Indians.

The first objective of the present study was to examine PYLL at ages 25 to 74 by cause of death among Métis and non-Status Indians, compared with non-Aboriginal adults.

The second objective was to assess the influence of socio-economic factors on disparities in premature mortality. Aboriginal peoples tend to rank less favourably than other Canadians on most measures of socio-economic status.[15,16] Unlike other mortality studies, which incorporate few if any socio-economic factors, the census mortality follow-up study has made it possible to include many such variables.

Methods

Data sources

The 1991 to 2001 Canadian census mortality follow-up study is a probabilistically linked cohort consisting of a 15% sample (n = 2,735,152) of the non-institutionalized population aged 25 or older, all of whom were enumerated via the 1991 census long-form questionnaire.[17] This cohort was tracked for mortality from June 4, 1991 through December 31, 2001.

Names were not captured on the census database, but they were needed for linkage to the mortality database. Consequently, creation of the mortality follow-up cohort required two probabilistic linkages. First, eligible census respondents were linked to a nominal list (name) file (abstracted from 1990 and 1991 tax-filer data and then encrypted) using common variables such as date of birth, postal code, and spousal date of birth (if applicable); 80% of eligible respondents were successfully matched. Second, the census plus encrypted names were matched to the Canadian Mortality Database.[18] Based on 1991 deaths (which could be identified independently in the Canadian Mortality Database and/or the name file), ascertainment of deaths from 1991 to 2001 of cohort members overall was estimated to be at least 95% among those reporting any Aboriginal ancestry, Registered Indian status, or membership in an Indian Band or First Nation.

Eligibility

People enumerated by the 1991 census long-form questionnaire who had reached age 25 by census day were eligible to be part of the cohort. The long form, which was usually given to 1 in 5 households, was administered to all residents of Indian reserves, many remote and northern communities, and non-institutional collective dwellings. However, 78 Indian reserves, representing about 38,000 people, were either not enumerated or incompletely enumerated,[19] and thus, were not part of the cohort. As well, the 1991 census missed 3.4% of Canadian residents; these individuals were more likely to be young, mobile, low income, of Aboriginal ancestry,[20] or homeless.

Owing to the exclusion of institutional residents and non-tax-filers, life expectancy of the cohort at age 25 was 1 year longer for men and 2 years longer for women, compared with the 1995 to 1997 life tables for all Canada. This bias would apply equally to Aboriginal and non-Aboriginal respondents and should not appreciably affect relative differences between the two groups.

Analytical techniques

The cohort was divided into ten one-year follow-up periods (June 4, 1991 to June 3, 1992; June 4, 1992 to June 3, 1993; and so on) and one seven-month period (June 4, 2001 to December 31, 2001). Age was transformed from age at baseline (June 4, 1991) to age at the beginning of each year of follow-up. Deaths and person-years at risk were calculated separately for each follow-up period, and then pooled by five-year age group (determined at the beginning of each year of follow-up). Deaths before age 75 were considered premature. The number of potential years of life lost (PYLL) was calculated by multiplying the number of deaths in each age group by the mean number of PYLL for the same age group. For example, the death of someone aged 25 to 29 would contribute 47.5 PYLL before age 75.

To calculate rates of PYLL, the number of person-years at risk (up to age 75) was determined for each five-year age group and the rates were age-standardized to the Aboriginal population. The Aboriginal age distribution was based on cohort members who indicated an Aboriginal ancestry, registration under the *Indian Act of Canada*, or membership in an Indian Band or First Nation. Confidence intervals for the age-standardized rates were produced from variances derived using the Spiegelman method.[21]

Premature mortality (Cox models)

For each cohort member, person-days of follow-up were calculated from baseline (June 4, 1991) to the date of death, emigration (known only for 1991), end of study (December 31, 2001), or until that individual reached age 75. Because exact date of birth was not available on the analysis file, age in completed years (as of June 4 of each follow-up year) was used to derive age at death and person-years of follow-up.

Cox proportional mortality hazard ratios were used to estimate the effect of socio-economic factors on the disparity in premature mortality among Métis and non-Status Indians, compared with non-Aboriginal adults. The variables included were age, marital status (married/common-law, not married), single parent (yes, no), educational attainment (less than secondary graduation, secondary graduation, postsecondary diploma, university degree), income adequacy quintile, labour force status (in, out), crowding (more than one person per room; yes, no), home ownership (yes, no), major dwelling repairs needed (yes, no), and urban population size (1 million or more; 500,000 to 999,999; 100,000 to 499,999; 10,000 to 99,999; and less than 10,000). Definitions of the variables are available in a previously published report[17] or the census dictionary.[22] All models were sex-specific. The base model (Model 1) controlled only for age. Models 2 to 7 controlled for age and one other variable. The full model (Model 8) controlled for age and all other variables simultaneously. Differences in excess mortality (1 minus the hazard

ratio) comparing the full model to the base model were interpreted as estimates of the effect of the socio-economic variables on the disparities.

Cause of death

The cause of death of cohort members who died during the study period had previously been coded to the World Health Organization's *International Classification of Diseases, Ninth Revision* (ICD-9)[23] for deaths occurring from 1991 through 1999, and to the *Tenth Revision* (ICD-10)[24] for deaths occurring in 2000 or 2001. Deaths were also grouped by Global Burden of Disease categories, which underscore human development rather than the body system,[25] and by risk factors, namely, smoking-related,[26] alcohol-related[26] and drug-related diseases,[27] or deaths potentially amenable to medical intervention (for instance, deaths due to cerebrovascular diseases, hypertension, breast cancer and pneumonia/influenza).

Definitions

The 1991 census did not collect information on self-identification with an Aboriginal group (North American Indian, Métis, or Inuit). For this analysis, Métis and non-Status Indians were defined based on two census questions reflecting ancestry and Registered Indian status.

1. To determine ancestry, respondents were asked to which ethnic or cultural group(s) their ancestors belonged.[22] From a list of 15 groups, including North American Indian, Métis and Inuit/Eskimo, respondents were instructed to check as many as applicable.
2. Registered Indian status was determined by a direct question: "Is this person a *Registered Indian* as defined by the *Indian Act of Canada*?" (yes, no).

In this study, respondents were considered Métis if they reported a single Métis ancestry (no other ancestries) or two or more Aboriginal ancestries with one being Métis. People were considered non-Status Indians if they reported a single North American Indian ancestry, but were not registered under the *Indian Act of Canada*.

Results

Characteristics differ

The demographic and socio-economic characteristics of Métis and non-Status Indian cohort members differed from those of non-Aboriginal members (Appendix Table A). Métis and non-Status Indians were younger and less likely to be legally married, to have completed secondary school, to be employed, and to be homeowners. They were more likely to be in the two lowest income adequacy quintiles, to live in crowded conditions, and to live in a dwelling needing major repairs. In 1991, nearly 7 out of 10 Métis cohort members were residents of Manitoba, Saskatchewan or Alberta, and about 7 out of 10 non-Status Indian cohort members were residents of Quebec, Ontario or British Columbia.

Age distribution of deaths

Of the deaths of cohort members that occurred during the 1991 to 2001 period, 71% among Métis and 76% among non-Status Indians were at ages 25 to 74, compared with 48% of the deaths among non-Aboriginal people (data not shown). And of those cohort members in this age range who died, Métis and non-Status Indians tended to be younger. For example, about 70% of Métis and non-Status Indian men and two-thirds of Métis and non-Status Indian women who

Table 1
Distribution of potential years of life lost (PYLL) by cause of death at ages 25 to 74 for Métis, non-Status Indian and non-Aboriginal men and women, non-institutional cohort members, Canada, 1991 to 2001

	Men			Women		
	Métis	Non-Status Indians	Non-Aboriginal	Métis	Non-Status Indians	Non-Aboriginal
Cohort members	5,600	2,600	1,245,100	6,000	2,800	1,230,600
Deaths acertained	374	190	80,251	260	134	40,958
PYLL rate*	12,025	11,480	5,984	6,139	8,844	3,134
	Percentage					
All causes	100.0	100.0	100.0	100.0	100.0	100.0
Communicable, maternal, perinatal and nutritional conditions	5.8	5.3	4.9	4.9	4.6	2.4
Non-communicable diseases	56.7	63.5	76.6	77.2	70.3	86.3
Malignant neoplasms	18.3	19.2	34.7	35.9	36.0	53.8
Trachea, bronchus, and lung cancers	6.7	9.8	10.9	6.6	6.8	11.7
Breast cancer	x	x	x	6.2	10.9	13.8
Neuropsychiatric conditions	5.0	5.8	2.7	8.0	1.8	2.8
Cardiovascular diseases	23.0	25.5	28.0	15.9	19.6	18.1
Ischemic heart disease	16.3	20.8	19.1	7.8	6.4	8.9
Digestive diseases	4.5	6.3	3.8	6.7	10.1	3.4
Cirrhosis of the liver	2.1	4.7	2.2	4.6	8.9	1.5
Injuries	34.5	29.5	16.2	15.3	22.5	9.4
Unintentional injuries	22.4	19.7	8.2	11.6	16.1	5.0
Road traffic accidents	9.1	9.2	3.4	5.0	3.0	2.7
Poisonings	3.1	2.3	1.0	4.5	7.8	0.7
Intentional injuries	10.7	7.9	7.5	3.7	6.3	4.1
Self-inflicted injuries (suicide)	8.7	x	7.0	x	x	3.6
Ill-defined causes	2.9	1.7	2.3	2.5	2.6	1.8

* per 100,000 person-years at risk, age-standardized to Aboriginal age distribution (five-year age groups)
x suppressed to meet the confidentiality requirements of the Statistics Act
Source: 1991 to 2001 Canadian census mortality follow-up study

died were younger than 65, compared with around half of the non-Aboriginal decedents.

Distribution of adult PYLL

The percentage distribution of potential years of life lost (PYLL) by various causes of death differed by Aboriginal ancestry and sex. Non-communicable (chronic) diseases ranked first, accounting for 57% and 64% of total PYLL for Métis and non-Status Indian men, respectively, and for 77% and 70%, respectively, for Métis and non-Status Indian women. Nonetheless, these percentages were below the corresponding figures for non-Aboriginal adults (Table 1). Cardiovascular diseases were the largest non-communicable disease subcategory for men (23% for Métis; 26% for non-Status Indians); for women, malignant neoplasms (cancer) were the largest subcategory (36% for both Métis and non-Status Indians).

Injuries accounted for much higher percentages of PYLL among the Aboriginal groups than non-Aboriginal adults. For men, injuries made up 35% of Métis PYLL and 30% of non-Status Indian PYLL, compared with 16% of non-Aboriginal PYLL. For women, the corresponding figures were 15%, 23% and 9%.

Rates of PYLL

Age-standardized rates of PYLL were much higher for Aboriginal than non-Aboriginal adults (Table 2). Compared with non-Aboriginal adults, PYLL rate ratios for Métis and non-Status Indian cohort members were around twice as high. Among Métis men, rate ratios were highest in the younger age groups and lowest at ages 55 to 74. Among non-Status Indian men, the rate ratio peaked at ages 45 to 54 and was lowest at ages 65 to 74. The pattern was less clear for Aboriginal women, among whom rate ratios were relatively high at ages 65 to 74.

Causes of death

To obtain a complete picture of mortality patterns, it is necessary to examine both relative and absolute inequalities in causes of death. If a cause of death is rare, the relative inequality can be quite high but account for a negligible number of deaths. On the other hand, a common cause of death can account for a large number of deaths (and be a significant contributor to absolute inequality), even if the relative risk is only slightly elevated. Thus, measuring relative (rate ratios) and absolute inequalities (rate differences) between Aboriginal and non-Aboriginal adults highlights specific causes that might be important in developing public health programs.

For most causes, PYLL rate ratios were elevated among Métis and non-Status Indians. Métis men had particularly high rate ratios for rheumatic heart disease, hypertensive heart disease, unintentional injuries, and violence (Table 3). Non-Status Indian men had high rate ratios for neuropsychiatric conditions including alcohol use disorders, digestive diseases such as cirrhosis of the liver, and road traffic accidents.

PYLL rate ratios for Métis and non-Status Indian women were elevated for almost all causes. Among Métis women, rate ratios were especially high for respiratory infections, leukemia, alcohol use disorders, hypertensive heart disease, chronic obstructive pulmonary diseases, cirrhosis of the liver, and unintentional injuries, notably poisoning (Table 4). Among non-Status Indian women, rate ratios were high for communicable diseases, breast cancer, cervix uteri cancer, cerebrovascular disease, cirrhosis of the liver, and unintentional injuries, especially poisoning.

Rate ratios for alcohol- and drug-related diseases were higher for Métis and non-Status Indians of both sexes than for their non-Aboriginal counterparts;

Table 2
Deaths, rates of potential years of life lost (RPYLL)* and rate ratios (RR) for Métis and non-Status Indians compared with non-Aboriginal men and women, by age group, non-institutional cohort members, Canada, 1991 to 2001

	Métis							Non-Status Indians							Non-Aboriginal			
			95% confidence interval			95% confidence interval				95% confidence interval			95% confidence interval				95% confidence interval	
Sex/Age	Number of deaths	RPYLL	from	to	RR	from	to	Number of deaths	RPYLL	from	to	RR	from	to	Number of deaths	RPYLL	from	to
Men	374	12,025	9,879	14,635	2.01	1.65	2.45	190	11,480	9,047	14,569	1.92	1.51	2.44	80,251	5,984	5,871	6,099
25 to 34	25	9,160	6,188	13,558	2.21	1.49	3.28	10	7,570	4,072	14,070	1.82	0.98	3.4	1,763	4,149	3,960	4,347
35 to 44	58	10,251	7,923	13,263	2.13	1.64	2.76	25	8,624	5,824	12,770	1.79	1.21	2.65	5,186	4,821	4,691	4,954
45 to 54	81	15,251	12,261	18,968	1.84	1.48	2.29	50	20,906	15,842	27,589	2.52	1.91	3.33	10,161	8,291	8,131	8,455
55 to 64	101	18,401	15,118	22,397	1.27	1.04	1.55	54	28,197	21,576	36,851	1.95	1.49	2.54	20,686	14,489	14,291	14,689
65 to 74	109	17,844	14,598	21,812	1.39	1.13	1.69	51	16,297	12,037	22,066	1.27	0.93	1.71	42,455	12,876	12,740	13,014
Women	260	6,139	5,000	7,537	1.96	1.59	2.41	134	8,844	6,456	12,115	2.82	2.06	3.87	40,958	3,134	3,062	3,207
25 to 34	9	2,716	1,412	5,223	1.60	0.83	3.1	10	6,601	3,550	12,274	3.90	2.09	7.28	771	1,694	1,578	1,818
35 to 44	46	6,743	5,049	9,005	2.37	1.77	3.18	25	7,729	5,219	11,444	2.72	1.83	4.03	3,223	2,842	2,745	2,942
45 to 54	47	8,874	6,662	11,822	1.71	1.28	2.28	24	9,883	6,618	14,760	1.91	1.28	2.85	6,239	5,182	5,054	5,313
55 to 64	66	14,707	11,529	18,761	1.86	1.46	2.38	28	13,851	9,531	20,129	1.76	1.21	2.55	10,008	7,887	7,732	8,045
65 to 74	92	12,259	9,736	15,436	1.93	1.54	2.44	47	16,286	11,893	22,302	2.57	1.88	3.52	20,717	6,337	6,240	6,435

* per 100,000 person-years at risk
Source: 1991 to 2001 Canadian census mortality follow-up study.

Table 3
Age-standardized rate ratios (RRs) and rate differences (RDs) for potential years of life lost at ages 25 to 74 for Métis and non-Status Indian men compared with non-Aboriginal men, by cause of death, non-institutional cohort members, Canada, 1991 to 2001

	Métis						Non-Status Indians					
		95% confidence interval			95% confidence interval			95% confidence interval			95% confidence interval	
	RR	from	to	RD	from	to	RR	from	to	RD	from	to
All causes	2.01	1.65	2.45	6,040	3,675	8,406	1.92	1.51	2.44	5,496	2,759	8,234
Communicable, maternal, perinatal and nutritional conditions	1.20	0.67	2.14	90	-226	406	1.78	0.70	4.57	358	-406	1,122
Infectious and parasitic diseases	1.12	0.57	2.19	48	-261	357	1.77	0.63	4.99	315	-437	1,067
HIV/AIDS	0.91	0.37	2.20	-33	-318	253	x	x	x	x	x	x
Respiratory infections	2.00	0.93	4.33	44	-22	110	x	x	x	x	x	x
Non-communicable diseases	1.42	1.16	1.73	1,463	461	2,466	x	x	x	x	x	x
Malignant neoplasms	1.17	0.76	1.80	262	-527	1,052	1.11	0.79	1.54	167	-411	745
Mouth and oropharynx cancers	0.68	0.15	3.00	-16	-67	35	x	x	x	x	x	x
Esophageal cancer	0.68	0.19	2.38	-15	-53	24	x	x	x	x	x	x
Stomach cancer	2.80	0.72	10.84	108	-119	335	x	x	x	x	x	x
Colon and rectal cancers	3.11	0.74	13.11	306	-341	953	0.72	0.23	2.30	-41	-162	81
Liver cancer	0.98	0.30	3.15	-1	-46	44	1.41	0.28	7.20	16	-75	107
Pancreas cancer	0.66	0.21	2.01	-27	-84	31	1.01	0.28	3.64	0	-100	101
Trachea, bronchus and lung cancers	1.23	0.79	1.90	95	-130	320	2.12	1.32	3.42	471	46	896
Prostate cancer	1.59	0.70	3.64	27	-33	86	1.30	0.50	3.42	14	-43	71
Bladder cancer	2.36	0.82	6.81	32	-26	90	x	x	x	x	x	x
Lymphomas and multiple myeloma	1.20	0.41	3.52	27	-147	201	x	x	x	x	x	x
Diabetes mellitus	1.37	0.67	2.82	35	-58	128	x	x	x	x	x	x
Endocrine disorders	0.23	0.06	0.94	-54	-80	-27	x	x	x	x	x	x
Neuropsychiatric conditions	2.89	1.62	5.17	295	37	554	3.73	1.77	7.85	426	-4	855
Alcohol use disorders	2.94	1.06	8.15	69	-36	174	8.15	3.18	20.90	254	-15	523
Cardiovascular diseases	1.48	1.16	1.89	593	146	1,039	1.98	1.41	2.78	1,213	386	2,040
Rheumatic heart disease	10.20	2.98	34.89	58	-18	133	x	x	x	x	x	x
Hypertensive heart disease	3.74	1.03	13.61	45	-31	121	x	x	x	x	x	x
Ischemic heart disease	1.62	1.21	2.17	500	118	881	2.50	1.71	3.66	1,213	443	1,983
Cerebrovascular disease	1.55	0.77	3.14	78	-75	232	1.92	0.74	4.97	129	-128	386
Inflammatory heart diseases	0.57	0.17	1.92	-26	-69	17	x	x	x	x	x	x
Respiratory diseases	1.17	0.57	2.40	16	-62	94	2.24	0.68	7.40	115	-132	363
Chronic obstructive pulmonary disease	1.55	0.66	3.66	28	-39	94	x	x	x	x	x	x
Digestive diseases	2.05	1.15	3.65	192	-23	407	3.27	1.72	6.25	416	31	800
Cirrhosis of the liver	1.74	0.76	4.00	77	-73	227	4.40	2.05	9.41	353	8	698
Genitourinary diseases	2.35	0.80	6.85	47	-40	133	x	x	x	x	x	x
Injuries	3.26	2.32	4.59	4,124	2,111	6,137	2.48	1.48	4.15	2,686	370	5,003
Unintentional injuries	4.56	2.97	7.01	3,348	1,531	5,165	2.93	1.58	5.42	1,810	123	3,498
Road traffic accidents	3.12	1.66	5.85	880	75	1,685	4.11	1.62	10.44	1,290	-292	2,873
Poisonings	3.83	1.59	9.25	300	-51	652	2.36	0.63	8.77	144	-182	470
Falls	2.39	0.79	7.26	78	-67	223	x	x	x	x	x	x
Drownings	14.80	4.24	51.68	696	-209	1,600	x	x	x	x	x	x
Intentional injuries	1.81	1.03	3.18	686	-169	1,542	1.75	0.62	4.92	629	-895	2,154
Self-inflicted injuries (suicide)	1.65	0.87	3.13	502	-310	1,315	x	x	x	x	x	x
Violence (homicide)	3.56	1.22	10.45	184	-84	453	x	x	x	x	x	x
Ill-defined	2.91	0.87	9.77	363	-305	1,031	0.83	0.26	2.65	-32	-216	153
Risk factor-related												
Smoking-related	1.20	0.84	1.71	118	-134	371	1.61	1.03	2.52	363	-69	794
Alcohol-related	4.70	2.54	8.68	476	109	843	5.39	2.89	10.07	566	138	994
Drug-related	1.83	0.87	3.86	142	-87	371	2.95	1.21	7.17	331	-109	772
Amenable to medical intervention	1.29	0.82	2.02	207	-207	621	1.53	0.73	3.18	379	-426	1,184

x suppressed to meet the confidentiality rexuirements of the Statistics Act
Source: 1991 to 2001 Canadian census mortality follow-up study.

the rate ratio for deaths due to diseases amenable to medical intervention was high among non-Status Indian women. The rate ratio for smoking-related diseases was significantly high for non-Status Indian men, but not women or for Métis of either sex.

Absolute inequalities as indicated by rate differences measure "excess" PYLL. Among men, excess PYLL for all-cause mortality was 6,040 per 100,000 person-years at risk for Métis, and 5,496 for non-Status Indians (Table 3). About two-thirds of the excess PYLL among Métis men was due to injuries (55%

Table 4
Age-standardized rate ratios (RRs) and rate differences (RDs) for potential years of life lost at ages 25 to 74 for Métis and non-Status Indian women compared with non-Aboriginal women, by cause of death, non-institutional cohort members, Canada, 1991 to 2001

	Métis						Non-Status Indians					
		95% confidence interval			95% confidence interval			95% confidence interval			95% confidence interval	
	RR	from	to	RD	from	to	RR	from	to	RD	from	to
All causes	1.96	1.59	2.41	3,005	1,744	4,267	2.82	2.06	3.87	5,710	2,926	8,495
Communicable, maternal, perinatal and nutritional conditions	5.19	1.59	16.95	384	-174	943	8.43	1.76	40.30	682	-522	1,886
Infectious and parasitic diseases	1.59	0.56	4.51	32	-56	120	x	x	x	x	x	x
Respiratory infections	13.77	2.76	68.78	316	-227	860	x	x	x	x	x	x
Non-communicable diseases	1.70	1.43	2.03	1,722	991	2,452	2.34	1.64	3.33	3,273	1,239	5,308
Malignant neoplasms	1.27	0.97	1.65	413	-102	928	2.18	1.26	3.78	1,829	-23	3,681
Stomach cancer	2.59	0.80	8.41	61	-55	176	x	x	x	x	x	x
Colon and rectal cancers	1.01	0.41	2.49	1	-107	108	1.26	0.43	3.74	31	-130	193
Pancreas cancer	0.74	0.18	3.01	-13	-67	40	x	x	x	x	x	x
Trachea, bronchus and lung cancers	1.12	0.69	1.81	35	-123	192	1.47	0.76	2.83	137	-145	418
Breast cancer	0.77	0.41	1.44	-99	-305	108	3.94	1.42	10.93	1,258	-462	2,977
Cervix uteri cancer	2.99	1.34	6.67	140	-24	304	4.10	1.44	11.64	218	-78	514
Ovarian cancer	1.64	0.67	3.98	56	-72	183	1.10	0.29	4.10	9	-118	136
Leukemia	3.95	1.25	12.49	135	-70	340	x	x	x	x	x	x
Diabetes mellitus	2.88	1.37	6.08	93	-11	196	1.87	0.49	7.12	43	-80	165
Neuropsychiatric conditions	4.98	2.73	9.07	359	96	623	1.33	0.35	5.03	30	-130	189
Alcohol use disorders	16.52	6.23	43.83	192	9	375	x	x	x	x	x	x
Cardiovascular diseases	1.72	1.26	2.36	332	86	578	3.05	1.87	4.99	943	258	1,629
Hypertensive heart disease	9.12	3.24	25.67	57	-7	121	x	x	x	x	x	x
Ischemic heart disease	1.94	1.22	3.08	189	10	369	1.98	1.05	3.74	197	-56	450
Cerebrovascular disease	1.48	0.75	2.89	58	-62	177	3.88	1.55	9.69	348	-80	776
Inflammatory heart diseases	1.53	0.27	8.55	10	-41	62	x	x	x	x	x	x
Respiratory diseases	3.87	1.77	8.47	208	-7	424	0.46	0.15	1.47	-39	-79	1
Chronic obstructive pulmonary disease	3.71	1.65	8.33	91	-8	189	x	x	x	x	x	x
Digestive diseases	4.07	2.12	7.83	294	43	545	6.93	3.53	13.62	567	124	1,010
Cirrhosis of the liver	6.42	2.80	14.72	238	7	470	13.31	6.27	28.24	542	108	975
Genitourinary diseases	2.48	0.68	9.11	40	-44	124	1.05	0.27	4.07	1	-37	39
Injuries	2.59	1.36	4.93	811	-31	1,653	4.27	2.18	8.38	1,665	210	3,119
Unintentional injuries	4.12	1.95	8.72	838	18	1,658	6.55	2.92	14.69	1,488	82	2,894
Road traffic accidents	1.85	0.82	4.18	143	-106	391	1.60	0.37	6.86	100	-288	488
Poisonings	23.27	7.38	73.40	655	-118	1,428	19.75	8.04	48.50	552	45	1,059
Intentional injuries	0.97	0.39	2.39	-8	-201	185	1.89	0.76	4.66	196	-179	570
Ill-defined	2.07	0.66	6.54	88	-106	282	2.10	0.52	8.46	91	-149	330
Risk factor-related												
Smoking-related	1.40	0.93	2.09	147	-61	356	1.90	0.97	3.72	334	-142	810
Alcohol-related	8.75	4.55	16.84	330	94	567	11.84	5.20	26.96	461	55	868
Drug-related	8.18	2.94	22.73	679	-103	1,462	5.95	2.43	14.56	468	-29	965
Amenable to medical intervention	1.87	1.18	2.97	675	10	1,340	4.26	2.20	8.24	2,514	349	4,679

x suppressed to meet the confidentiality requirements of the Statistics Act
Source: 1991 to 2001 Canadian census mortality follow-up study.

Table 5
Hazard ratios for death before age 75 among Métis and non-Status Indians compared with non-Aboriginal cohort members, controlling for selected demographic, economic, housing and geographic factors, by sex, non-institutional cohort members aged 25 to 74, Canada, 1991 to 2001

Model number and name	Adjusted for:	Men						Women					
		Métis			Non-Status Indians			Métis			Non-Status Indians		
		Hazard ratio	95% confidence interval from	to	Hazard ratio	95% confidence interval from	to	Hazard ratio	95% confidence interval from	to	Hazard ratio	95% confidence interval from	to
1 Age	Age	1.52	1.37	1.68	1.76	1.53	2.03	1.99	1.76	2.24	2.27	1.92	2.69
2 Family structure	Age + marital status + single parent	1.37	1.23	1.51	1.59	1.38	1.84	1.88	1.67	2.13	2.14	1.80	2.53
3 Education	Age + education	1.35	1.22	1.50	1.57	1.36	1.81	1.83	1.62	2.07	2.11	1.78	2.50
4 Income	Age + income	1.31	1.19	1.45	1.54	1.33	1.77	1.78	1.57	2.01	2.05	1.73	2.42
5 Work status	Age + labour force	1.38	1.25	1.53	1.59	1.38	1.83	1.85	1.64	2.09	2.14	1.80	2.53
6 Housing	Age + crowding + home ownership + major repairs needed	1.38	1.25	1.53	1.58	1.37	1.82	1.85	1.64	2.1	2.11	1.78	2.50
7 Geography	Age + urban population size	1.48	1.34	1.64	1.74	1.51	2.01	1.95	1.73	2.21	2.26	1.91	2.68
8 Full	Age + family structure + education + income + work status + housing + geography	1.11	1.00	1.23	1.28	1.11	1.48	1.57	1.39	1.78	1.83	1.54	2.16

Source: 1991 to 2001 Canadian census mortality follow-up study.

unintentional, 11% intentional), and one-quarter was due to non-communicable diseases, notably, cardiovascular disease (data not shown). Among non-Status Indian men, injuries accounted for 48%, and non-communicable diseases, 45% of excess PYLL.

Excess PYLL was 3,005 per 100,000 person-years at risk for Métis women and 5,710 for non-Status Indian women (Table 4). More than half (57%) of the excess PYLL in both groups was due to non-communicable diseases (data not shown). Injuries accounted for 27% of excess PYLL for Métis women and 29% for non-Status Indian women; and communicable diseases, 13% and 12%, respectively. Results differed more for specific causes of death; for example, breast cancer was a major contributor to excess PYLL for non-Status Indian women (22%), but not for Métis women.

Socio-economic factors

Compared with non-Aboriginal men, the age-adjusted hazard ratio for dying before age 75 was 1.52 for Métis and 1.76 for non-Status Indians (Table 5, Model 1). However, socio-economic factors (such as education, income, housing, and labour force status) were important contributors to premature mortality. Six additional models (Models 2 to 7) were run, each adjusting for age and one other socio-economic variable. Except for Model 7, which controlled for geographic variables, the hazard ratios were attenuated compared with Model 1, suggesting that each variable had an effect on the disparity in premature mortality. In Model 8, which controlled for age and all the socio-economic factors simultaneously, the hazard ratios were reduced from 1.52 (Model 1) to 1.11 for Métis men and from 1.76 (Model 1) to 1.28 for non-Status Indian men. Among women, the corresponding reductions in hazard ratios were from 1.99 to 1.57 for Métis and from 2.27 to 1.83 for non-Status Indians.

Discussion

The PYLL rates for Métis and non-Status Indian members of the census mortality follow-up cohort were about twice those of non-Aboriginal members. Because this is the first study of PYLL among Métis and non-Status Indians, direct comparisons with earlier research are not possible. However, the estimates are consistent with calculations of PYLL (at ages 1 to 74) for Status Indians in Manitoba[12] and British Columbia.[13] Slightly lower rate ratios in the present study could reflect the exclusion of persons younger than 25, among whom PYLL rate disparities between Aboriginal and non-Aboriginal people are greatest.[28] As well, a companion article that examined PYLL among *Status Indian* members of the cohort reported rate ratios more than twice those of non-Aboriginal adults (see "Potential years of life lost at ages 25 to 74 among Status Indians, 1991 to 2001" in this issue).

Cardiovascular diseases, notably ischemic heart disease, were a major contributor to total PYLL for Métis, non-Status Indian and non-Aboriginal cohort members alike. Relative inequalities (compared with non-Aboriginal adults) for Métis and non-Status Indians were modestly elevated (ranging from 1.5 to 3.0), but due to the high incidence of cardiovascular disease deaths, they were large contributors to excess PYLL (about 10% for non-Status Indian and Métis men, and 17% to 22% for non-Status and Métis women). These findings confirm the growing importance of cardiovascular disease in various Aboriginal populations.[29,30] They also support studies showing the high prevalence of cardiovascular risk factors such as smoking,[31] obesity,[32] metabolic syndrome,[33,34] hypertension and type 2 diabetes[35] in some Aboriginal populations.

Cancer, too, was a significant contributor to total PYLL. For men,

Why is this study important?

- Relatively little mortality information exists about Métis and non-Status Indians.

What else is known on this topic?

- Rates of potential years of life lost are higher for First Nations registered under the *Indian Act* (Status Indians), with injury deaths the largest contributor.

What does this study add?

- For Métis and non-Status Indians, rates of potential years of life lost (at ages 25 to 74) were about twice as high as for non-Aboriginal people.
- Both absolute and relative inequalities were particularly elevated for injuries.
- Socio-economic factors such as income, education, housing and employment explained a substantial proportion of excess premature mortality among Métis and non-Status Indians.

relative inequalities among Métis and non-Status Indians men were slightly elevated, which resulted in somewhat higher absolute inequalities. For women, both relative and absolute cancer inequalities were substantially higher among Métis and non-Status Indians. Consistent with other research,[10,36-39] relative and absolute inequalities varied by cancer subtypes.

Earlier studies have shown Status Indians to be at greater risk of dying from intentional and unintentional injuries.[13,40] In this analysis, injury deaths made up a large share of total PYLL among Métis and non-Status Indian cohort members. Both absolute and relative inequalities were significantly elevated, with relative risks ranging from 2.5 to 4.3, and injuries contributing sizeable percentages of excess PYLL. These results illustrate the public health importance of injury prevention for Aboriginal adults.[12]

Compared with non-Aboriginal adults, the rates of PYLL for alcohol-related diseases were about five times higher for Métis and non-Status Indian men and more than eight times higher times for women. Moreover, these rates do not include deaths (due to injury, for example) in which alcohol may have been a contributing factor. A British Columbia study of Status Indians also reported a high age-standardized mortality rate for alcohol-related deaths.[13]

The disproportionate burden of illness and death among Aboriginal peoples is thought to be the product of a wide range of social determinants that are experienced throughout the lifetime.[16,41,42] The results of this analysis are similar to other population-based studies demonstrating the importance of socio-economic status as a contributor to health inequalities.[10,43] Factors such as education, income, housing, and labour force status were significantly associated with the disparity in premature mortality compared with non-Aboriginal adults. Nevertheless, these variables did not explain all of the disparity in premature death, suggesting that factors not assessed in this study contribute to the inequality.

Limitations

The results apply to non-institutional census respondents aged 25 or older who filed taxes. This cohort is healthier than the Canadian population overall, so caution should be exercised when generalizing these results to the entire Métis, non-Status Indian and non-Aboriginal adult populations (which include institutional residents and non-tax-filers).

A question on Aboriginal self-identity was not asked on the 1991 census. Therefore, this study used the ancestry-based definition. It is estimated that more than 90% of individuals defined as Métis or non-Status Indians in this study would also self-identify as Aboriginal. Nonetheless, changes in Aboriginal self-identification over the past 20 years[44] mean that care must be taken when comparing these results with those of more recent censuses.

Ascertainment of deaths among Aboriginal cohort members is estimated to be slightly lower than that for the cohort as a whole. This would be expected to exert a slight downward bias in calculated mortality rates for Métis and non-Status Indians, so the true extent of the disparities could be slightly larger than indicated here.

Due to the small number of cohort members who were non-Status Indian or Métis, confidence intervals for some causes of deaths were wide, thereby limiting the detection of statistically significant differences in PYLL between Métis or non-Status Indians and non-Aboriginal adults.

Conclusion

This study adds to the information about mortality among Métis and non-Status Indians in Canada. These two Aboriginal groups had significantly higher rates of potential years of life lost, compared with non-Aboriginal adults. As was the case for non-Aboriginal adults, the largest losses of potential years of life among Métis and non-Status Indians were due to non-communicable (chronic) diseases such as cancers and cardiovascular diseases. However, injuries were a major contributor to disparities in premature mortality, as were alcohol- and drug-related deaths. The findings highlight the prevalence of premature mortality due to chronic diseases and the public health importance of injury, alcohol and drug prevention programs. The results are also in line with other research demonstrating the significant role of socio-economic factors. ■

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Appendix

Table A
Selected characteristics of Métis, non-Status Indians and non-Aboriginal men and women, non-institutional cohort members aged 25 to 74, Canada, 1991

	Men			Women		
	Métis	Non-Status Indians	Non-Aboriginal	Métis	Non-Status Indians	Non-Aboriginal
Total number	5,600	2,600	1,245,100	6,000	2,800	1,230,600
	Percentage					
Percentage	100	100	100	100	100	100
Age group						
25 to 34	39	41	28	44	44	30
35 to 44	29	30	27	29	31	28
45 to 54	18	16	19	15	14	18
55 to 64	11	8	15	8	8	13
65 to 74	4	5	11	5	4	11
Marital status						
Single (never married)	20	19	14	16	16	11
Common-law	20	19	7	17	17	6
Married	51	54	73	49	50	66
Previously married	9	8	7	18	18	16
Single parent	3	2	2	20	16	8
Homeowner	55	54	75	51	52	72
Overcrowding	13	9	2	14	10	2
Dwelling in need of major repairs	25	20	7	25	17	7
Educational attainment						
Less than secondary graduation	53	51	33	50	46	32
Secondary graduation	35	39	38	31	37	36
Postsecondary diploma	8	7	13	14	13	19
University degree	4	3	16	5	3	13
Income adequacy quintile						
1 (lowest)	29	27	13	36	33	17
2	23	23	18	22	22	19
3	20	23	21	18	19	21
4	18	17	23	15	16	21
5 (highest)	11	10	24	9	10	21
Labour force status						
Employed	62	65	76	48	52	63
Unemployed	18	15	7	11	9	6
Not in labour force	19	20	17	42	39	32
Region						
Atlantic	2	7	8	2	7	8
Quebec	8	38	26	7	40	26
Ontario	8	19	37	8	18	37
Manitoba	24	6	4	24	5	4
Saskatchewan	22	8	3	23	8	3
Alberta	22	8	9	22	7	9
British Columbia	6	11	12	5	10	12
Territories	8	3	1	8	3	1
Community size						
1,000,000 or more	6	20	31	5	22	33
500,000 to 999,999	15	14	16	15	15	17
100,000 to 499,999	5	9	15	6	9	16
10,000 to 99,999	15	14	14	16	15	14
Less than 10,000	59	42	23	58	39	21
Living in First Nations community	7	7	0	8	5	0

Source: 1991 to 2001 Canadian census mortality follow-up study.